THE LUNAR OBSERVER

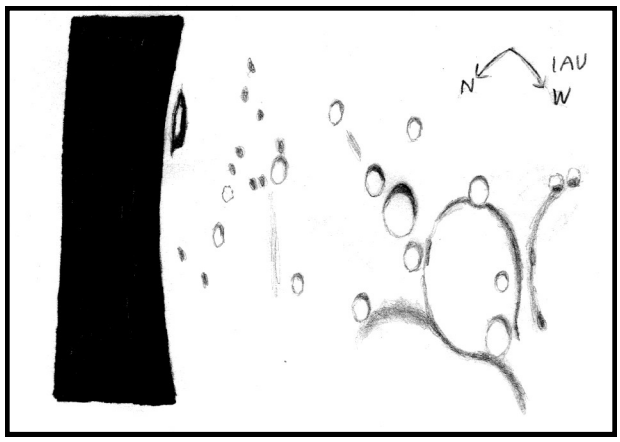
A PUBLICATION OF THE LUNAR SECTION OF THE A.L.P.O.

EDITED BY: Wayne Bailey wayne.bailey@alpo-astronomy.org
14120 S. Mica Place, Tucson, AZ 85736

RECENT BACK ISSUES: http://moon.scopesandscapes.com/tlo_back.html

FEATURE OF THE MONTH – MARCH 2019

EUCTEMON & Dark Ring



Sketch and text by Robert H. Hays, Jr. - Worth, Illinois, USA
December 19, 2018 01:05-01:35, 02:58-03:10 UT, 15 cm refl, 170x, seeing 7-8/10, transparency 6/6.

I sketched this area on the evening of Dec. 18/19, 2018. This area is well north of Mare Frigoris. Librations were favorable, but it was rather far from the terminator, so most shadowing was relatively light. Euctemon is a large shallow crater with Euctemon H on its southwest rim and Euctemon N intruding on its east side. Euctemon K is inside the south rim of Euctemon, but no other detail was noticed inside the main crater. Grayish curved strips of shadowing west and south of Euctemon may be parts of larger rings. Two large peaks south of Euctemon N are on one of these strips. Euctemon D is the largest crater north of Euctemon. This crater, along with its neighbor to the north, had the darkest shadowing at this time, and were probably deepest. A crater just north of Euctemon certainly appeared shallower than D nearby. Other rings in this view all looked similar to Euctemon N for example. Several gray spots along with one small bright patch were of indeterminate nature. The main feature of interest in this area is a very dark ring near the limb. This feature was darker than any shading on this sketch and really stood out in that area. It does not appear to be ordinary shadow. The interior may be round like a crater, but it's hard to tell because of foreshortening. This dark ring is widest on its north side, and there is a sharp point on that side near the limb. In its own way, this ring may be as much a mystery as Reiner gamma.

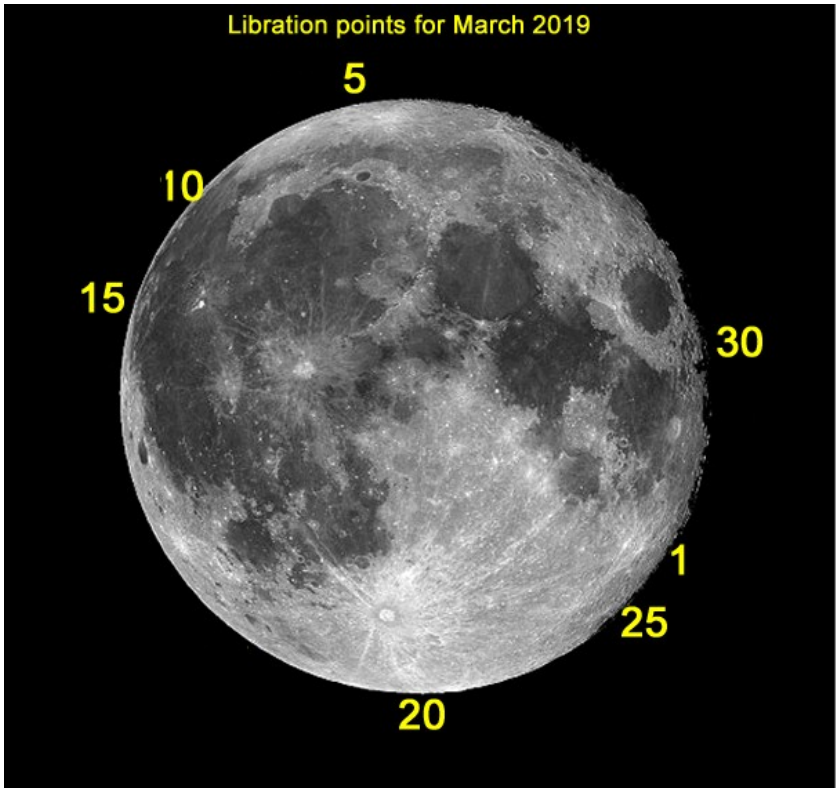
LUNAR CALENDAR

2019	U.T.	EVENT
Mar 01	06:23	Moon South Dec.: 21.6° S
01	18:40	Moon-Saturn: 0.3° S
02	11:03	Moon Descending Node
02	21:28	Moon-Venus: 1.3° N
04	21:25	Moon Apogee: 406400 km
06	16:04	New Moon
14	10:27	First Quarter
15	17:59	Moon North Dec.: 21.8° N
16	16:22	Moon Ascending Node
19	19:47	Moon Perigee: 359400 km
21	01:43	Full Moon
27	02:28	Moon-Jupiter: 2° S
28	04:10	Last Quarter
28	13:02	Moon South Dec.: 21.9° S
29	05:11	Moon-Saturn: 0.1° N
29	13:08	Moon Descending Node

2019	U.T.	EVENT
Apr 01	00:14	Moon Apogee: 405600 km
02	04:17	Moon-Venus: 3° N
02	23:01	Moon-Mercury: 4° N
05	08:50	New Moon
09	06:40	Moon-Mars: 5° N
11	23:59	Moon North Dec.: 22° N
12	18:08	Moon Ascending Node
12	19:06	First Quarter
16	22:02	Moon Perigee: 364200 km
19	11:12	Full Moon
23	11:36	Moon-Jupiter: 1.8° S
24	21:22	Moon South Dec.: 22.1° S
25	14:38	Moon-Saturn: 0.4° N
25	15:02	Moon Descending Node
26	22:18	Last Quarter
28	18:20	Moon Apogee: 404600 km

LUNAR LIBRATION

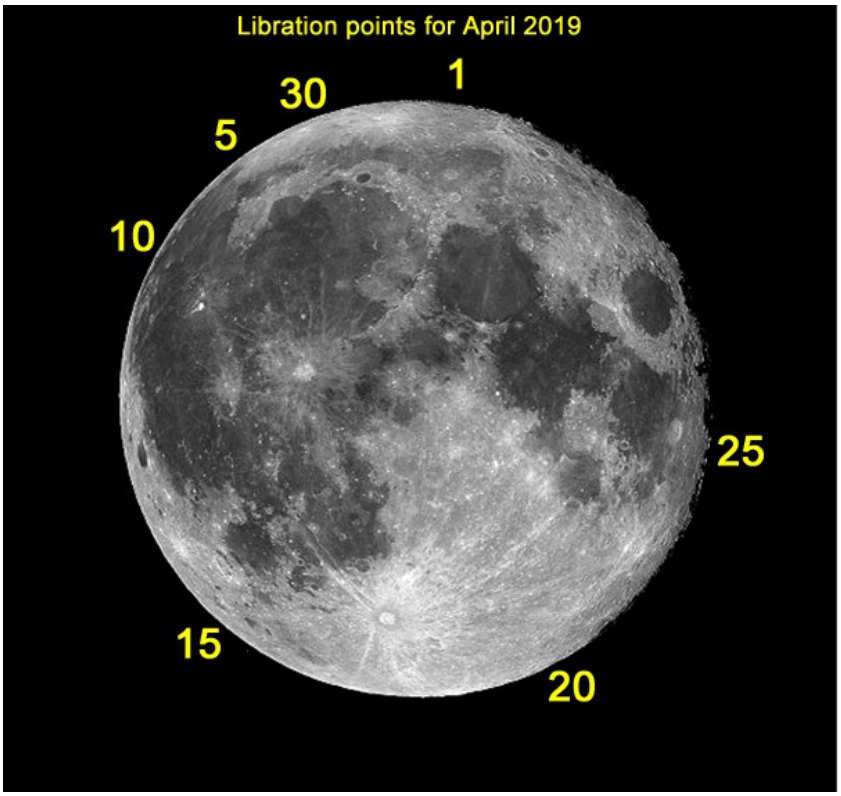
MARCH—APRIL 2019



Size of Libration

03/01	Lat	-01°59'	Long	+05°06'
03/05	Lat	+03°23'	Long	-00°24'
03/10	Lat	+06°38'	Long	-05°53'
03/15	Lat	+02°39'	Long	-06°46'
03/20	Lat	-05°02'	Long	-00°02'
03/25	Lat	-05°33'	Long	+06°49'
03/30	Lat	+00°38'	Long	+03°24'

NOTE:
Librations are based on a geocentric position at 0 hr. Universal Time.



Size of Libration

04/01	Lat	+03°13'	Long	+00°35'
04/05	Lat	+06°24'	Long	-04°04'
04/10	Lat	+04°01'	Long	-05°55'
04/15	Lat	-03°28'	Long	-02°47'
04/20	Lat	-06°19'	Long	+04°22'
04/25	Lat	-00°55'	Long	+04°48'
04/30	Lat	+05°12'	Long	-01°30'

NOTE:
Librations are based on a geocentric position at 0 hr. Universal Time.

2019 ALPO MEETING

The 2019 Annual Meeting of the Association of Lunar and Planetary Observers will be held, combined with the South East Region Astronomical League, at Gordon College in Barnesville, GA the weekend of July 12-14.

Additional information will be available in the JALPO and included here as it becomes available.

AN INVITATION TO JOIN THE A.L.P.O.

The Lunar Observer is a publication of the Association of Lunar and Planetary Observers that is available for access and participation by nonmembers free of charge, but there is more to the A.L.P.O. than a monthly lunar newsletter. If you are a nonmember you are invited to join our organization for its many other advantages.

We have sections devoted to the observation of all types of bodies found in our solar system. Section coordinators collect and study members' observations, correspond with observers, encourage beginners, and contribute reports to our Journal at appropriate intervals.

Our quarterly journal, **The Journal of the Association of Lunar and Planetary Observers-The Strolling Astronomer**, contains the results of the many observing programs which we sponsor including the drawings and images produced by individual amateurs. Additional information about the A.L.P.O. and its Journal is on-line at: **http://www.alpo-astronomy.org.** I invite you to spend a few minutes browsing the Section Pages to learn more about the fine work being done by your fellow amateur astronomers.

To learn more about membership in the A.L.P.O. go to: **http://www.alpo-astronomy.org/main/member.html** which now also provides links so that you can enroll and pay your membership dues online.

SUBMISSION THROUGH THE ALPO IMAGE ARCHIVE

ALPO's archives go back many years and preserve the many observations and reports made by amateur astronomers. ALPO's galleries allow you to see on-line the thumbnail images of the submitted pictures/observations, as well as full size versions. It now is as simple as sending an email to include your images in the archives. Simply attach the image to an email addressed to

lunar@alpo-astronomy.org (lunar images).

It is helpful if the filenames follow the naming convention :

FEATURE-NAME_YYYY-MM-DD-HHMM.ext

YYYY {0..9} Year
MM {0..9} Month
DD {0..9} Day
HH {0..9} Hour (UT)
MM {0..9} Minute (UT)
.ext (file type extension)
(NO spaces or special characters other than "_" or "-". Spaces within a feature name should be replaced by "-".)

As an example the following file name would be a valid filename:

Sinus-Iridum_2018-04-25-0916.jpg
(Feature Sinus Iridum, Year 2018, Month April, Day 25, UT Time 09 hr16 min)

Additional information requested for lunar images (next page) should, if possible, be included on the image. Alternatively, include the information in the submittal e-mail, and/or in the file name (in which case, the coordinator will superimpose it on the image before archiving). As always, additional commentary is always welcome and should be included in the submittal email, or attached as a separate file.

If the filename does not conform to the standard, the staff member who uploads the image into the data base will make the changes prior to uploading the image(s). However, use of the recommended format, reduces the effort to post the images significantly.

Observers who submit digital versions of drawings should scan their images at a resolution of 72 dpi and save the file as a 8 1/2"x 11" or A4 sized picture.

Finally a word to the type and size of the submitted images. It is recommended that the image type of the file submitted be jpg. Other file types (such as png, bmp or tif) may be submitted, but may be converted to jpg at the discretion of the coordinator. Use the minimum file size that retains image detail (use jpg quality settings. Most single frame images are adequately represented at 200-300 kB). However, images intended for photometric analysis should be submitted as tif or bmp files to avoid lossy compression.

Images may still be submitted directly to the coordinators (as described on the next page). However, since all images submitted through the on-line gallery will be automatically forwarded to the coordinators, it has the advantage of not changing if coordinators change.

When submitting observations to the A.L.P.O. Lunar Section

In addition to information specifically related to the observing program being addressed, the following data should be included:

Name and location of observer
Name of feature
Date and time (UT) of observation (use month name or specify mm-dd-yyyy-hhmm or yyyy-mm-dd-hhmm)
Filter (if used)
Size and type of telescope used Magnification (for sketches)
Medium employed (for photos and electronic images)
Orientation of image: (North/South - East/West)
Seeing: 0 to 10 (0-Worst 10-Best)
Transparency: 1 to 6

Resolution appropriate to the image detail is preferred-it is not necessary to reduce the size of images. *Additional commentary accompanying images is always welcome.* **Items in bold are required. Submissions lacking this basic information will be discarded.**

Digitally submitted images should be sent to both
Wayne Bailey – wayne.bailey@alpo-astronomy.org
and Jerry Hubbell –jerry.hubbell@alpo-astronomy.org

Hard copy submissions should be mailed to Wayne Bailey at the address on page one.

CALL FOR OBSERVATIONS:
FOCUS ON: Apollo 12 Region – Ocean of Storms

Focus on is a bi-monthly series of articles, which includes observations received for a specific feature or class of features. The subject for the **May 2019** edition will be the Apollo 12 Region – Ocean of Storms**.** Observations at all phases and of all kinds (electronic or film based images, drawings, etc.) are welcomed and invited. Keep in mind that observations do not have to be recent ones, so search your files and/or add these features to your observing list and send your favorites to (both):

Jerry Hubbell –jerry.hubbell@alpo-astronomy.org
Wayne Bailey - wayne.bailey@alpo-astronomy.org

Deadline for inclusion in the Apollo 12 Region – Ocean of Storms article is April. 20, 2019

FUTURE FOCUS ON ARTICLES:

In order to provide more lead time for contributors the following future targets have been selected:

Subject	TLO Issue	Deadline
Apollo 11 Region – 50th Anniversary – Sea of Tranquility	July 2019	June 20, 2019

Focus On: Apollo 14 – The Fra Mauro Formation

Jerry Hubbell
Assistant Coordinator, Lunar Topographical Studies

This is the fourth in a series of six TLO Focus On articles on the Apollo lunar landing missions that will end on the 50th anniversary of the Apollo 11 mission in the July 2019 issue of TLO. To learn about the background and thinking behind this series of articles to commemorate the Apollo program see the September 2018 TLO Focus On article.

Figure 1. *Apollo 14 Mission Patch, NASA image.*

Apollo 15 was launched on July 26, 1971, at 9:34 AM EDT from the Kennedy Space Center. The crew consisted of Commander Alan Shepard, Command Module Pilot Stuart Roosa, and Lunar Module Pilot Edgar Mitchell. (Figure 2.) After landing in the Fra Mauro highlands, on February 5, 1971, at 4:18 AM EST the lunar module crew spent a little less than 1.5-days on the surface and performed 2 EVA's during their stay.

Figure 2. *Apollo 14 Astronauts. (from left to right, Edgar Mitchell, Alan Shepard, and Stuart Roosa. NASA image.*

Apollo 14 was the last of the "H missions". These were targeted landings with two-day stays on the Moon with two lunar EVAs. The mission objectives were to explore the Fra Mauro region, set up and activate lunar surface scientific experiments, evaluate new Apollo equipment, and conduct lunar orbital experiments and photographic the lunar surface from orbit.

The US Geological Survey Professional Paper 880 provides the following:

> *"Apollo 14 landed in the Fra Mauro highlands on February 5, 1971, at latitude 3°40'24" S., longitude 17°27'55" W. The materials of the area are interpreted to be part of the large deposit of ejecta from the Imbrium basin and appear to be older than the materials of the maria. Because of its relatively old age, the regolith is thicker than on the typical mare, and the ages of the various surfaces within the landing site are reflected in the size-frequency distribution of rock fragments. Since lunar materials generally darken with age, their albedos serve as a general indication of the relative length of time that they have been exposed at the surface. Polarimetric properties and albedo appear to be useful signatures for comparative studies of lunar materials. The Fra Mauro Formation at the Apollo 14 site comprises breccias that were formed by the Imbrium event and possibly other, earlier impact events. One type of breccia consists of mostly dark clasts in a lighter matrix; the other type, a mixture of light- and medium-gray clasts in a dark matrix. The origin of the breccias and the effects of exposure on the lunar surface are suggested by structures and textures of boulders photographed along the astronauts' traverse line"*

In the report of the Apollo 14 mission by the NASA Lyndon B. Johnson Space Center, Houston, Texas for the Curator, NASA:

> *"After the successful return of numerous basalt samples from the mare regions by the Apollo 11 and 12 missions, it was desirable to sample a different kind of area. For this reason, a major objective of the Apollo 14mission, was to sample material comprising the Fra Mauro Formation, which had been interpreted as being a portion of the ejecta blanket deposited during the impact formation of the Imbrium Basin (Gilbert, 1893; Eggleton, 1964; Wilhelms, 1970). This event was believed to predate mare formation, and it was hoped that an age for the Imbrium event could be established through successful return of these samples..."*

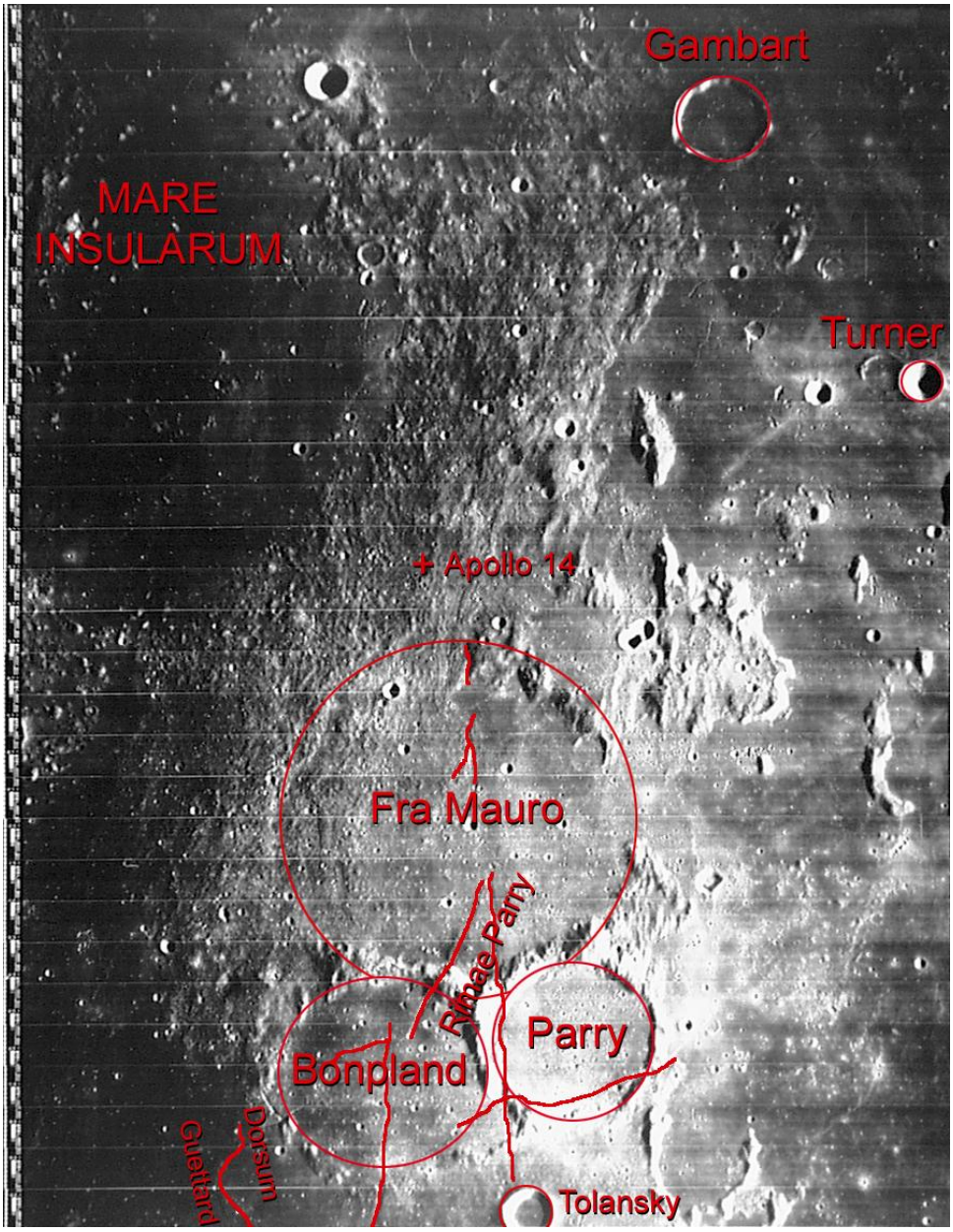


Figure 3. *Apollo 14 Landing Site – Fra Mauro Formation and Region, Lunar Orbiter Photo Number IV-120-H3*

"…The Fra Mauro region and the Fra Mauro Formation are named for the crater Fra Mauro, an ancient, eroded, and partially buried crater 70 km south of the landing site. The Fra Mauro Formation is a distinctive ridged and furrowed unit surrounding the Imbrium Basin. This formation had traditionally been interpreted as fragmental ejecta from the Imbrium Basin since the idea was first proposed by G. K. Gilbert in 1893. In recent years, however, this idea has met with some challenge by investigators who point out that much local material excavated by secondary cratering is admixed with the Imbrium Basin material (Morrison and Oberbeck, 1975). The thickness of the Fra Mauro Formation is not known, and estimates vary by an order of magnitude. Offield (1970) estimates the thickness to be between 100 and 200 meters based on its relation to the local topography, while Kovach (1971) finds it to be only 20 - 70 meters thick, using results from the active seismic experiment by the Apollo 14 astronauts. It is seen to cover 26,000 km2 in the region of the landing site, feathering to a thin edge in the vicinity of the (crater Bonpland approximately 150 km to the south. A northwest-trending ridge, radial to the Imbrium Basin lies about 600 meters east of the smooth terrain of the landing site. At the crest of this ridge is Cone Crater, a relatively young crater 340 meters deep. Here, it becomes important to know the thickness of the Fra Mauro Formation, for some of the material collected at station C1 (figure 2) is interpreted to be Cone Crater ejecta. The question is whether this material is from the Fra Mauro Formation, or from the underlying material. The relief of the ridge is 90 meters. If Cone Crater is only 70 - 80 meters deep, chances are the ejecta represents Fra Mauro material…"

The Fra Mauro region has plenty of craters, rimae or rilles and other interesting features to observe and image with the small telescope. The main feature, Fra Mauro crater is located southeast of Mare Imbrium and is 58 mi. (96 km) in diameter and located at Selenographic coordinates, Lat 6.061° S, Lon 16.974° W. Companion craters Parry, diameter 29 mi. (48 km), Bonpland, diameter 36 mi. (60 km), and Guericke, diameter 35 mi. (58 km), further to the south, are all very interesting objects to observe. Rimae Parry is a well developed rille system that stretches across Parry, Bonpland, and Fra Mauro for 182 mi. (300 km).

Alberto Martos, Antonio Noya, Raquel R. Mediavilla, Jaime Izquierdo and Carlos de Luis, members of the Lunar Group of the Madrid Amateur Astronomy Society provide the following comments (extracted from their extensive report on the Fra Mauro Highlands).

"…A closer observation of the Fra Mauro Formation near the terminator and under high power optics (240x), allowed to discern some more details of the triple group (Figure 4). Fra Mauro is not so round as it looks like under low power optics. Its rim is flattened at south by intrusions produced by the two younger companions Bonpland and Parry. And the whole Fra Mauro seems to have smashed an older and smaller crater, whose north rim protrudes partially below it, at north. Besides this, the rim has been severely damaged by ejecta and interrupted at two points, at the eastern border, leaving a clear pass (a "strait") to lavas from Mare Insularum and Mare Nubium to invade the interior; and at north, where a long cleft, a branch of Rimae Parry, penetrates the wall and traverses the floor from north to south. This rille splits the floor in two semicircles; the eastern part is overlaid by light plain soil and presents a few secondary craters of concave floor. The western part is covered by a layer of hummocky terrain that extends from the flat floored crater Gambart (or even from the magnificent Copernicus) until the western rim of Bonpland. We could see only two small craters on this part. This hummocky layer that has buried the remnant of the older crater located underneath Fra Mauro and overlies the western half of it, is the so-called Fra Mauro Formation."

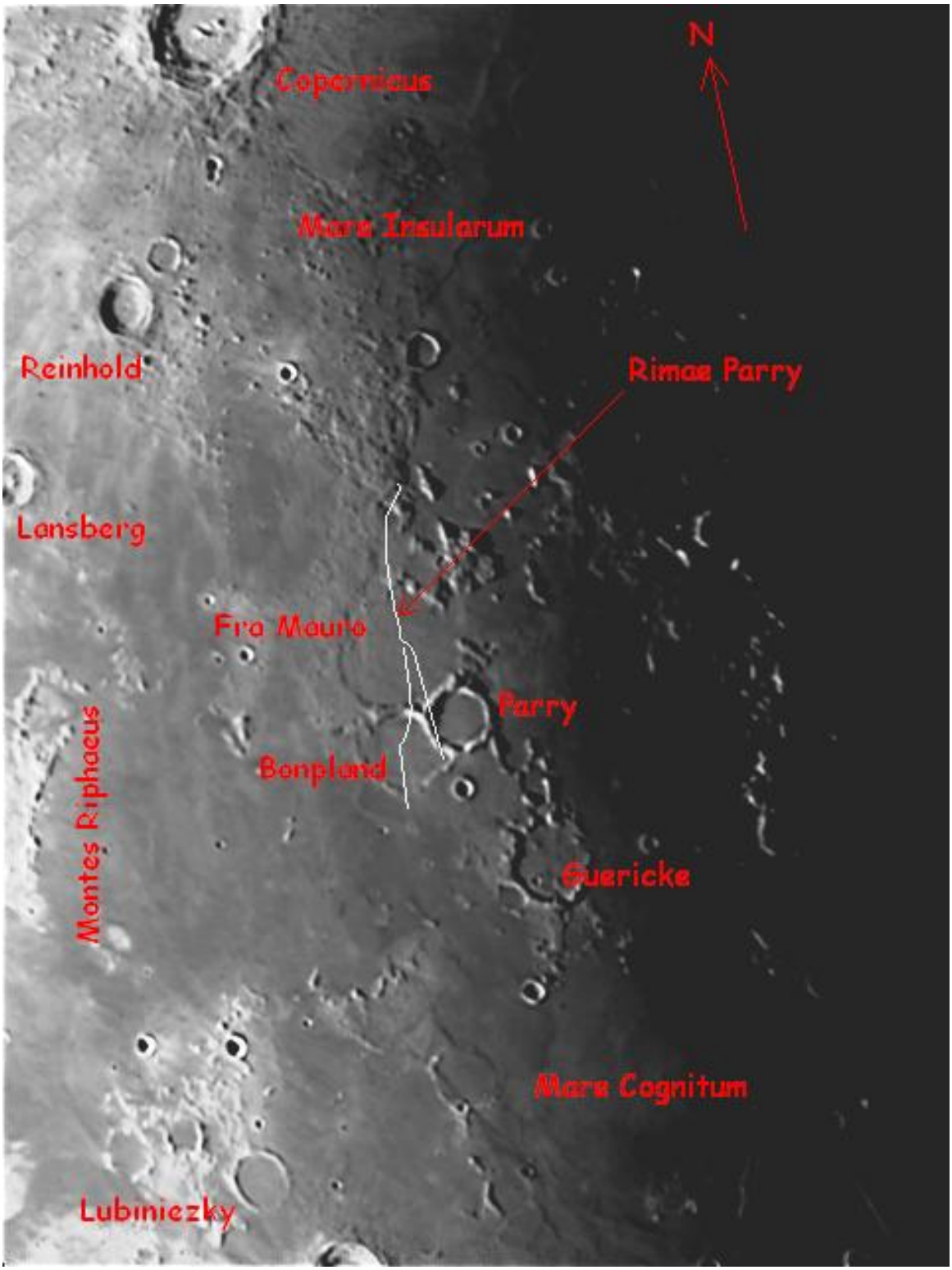


Figure 4. *Fra Mauro at sunset, Alberto Martos, et al., Lunar Group of the Madrid Amateur Astronomy Society, Madrid, Spain. 05 September 2007 0442 UT. Colongitude, 188°, Telescope, 20-cm f/7.3 Newtonian reflector, Philips TouCam Pro. Visibility, 3/5 Transparency, 4/5*

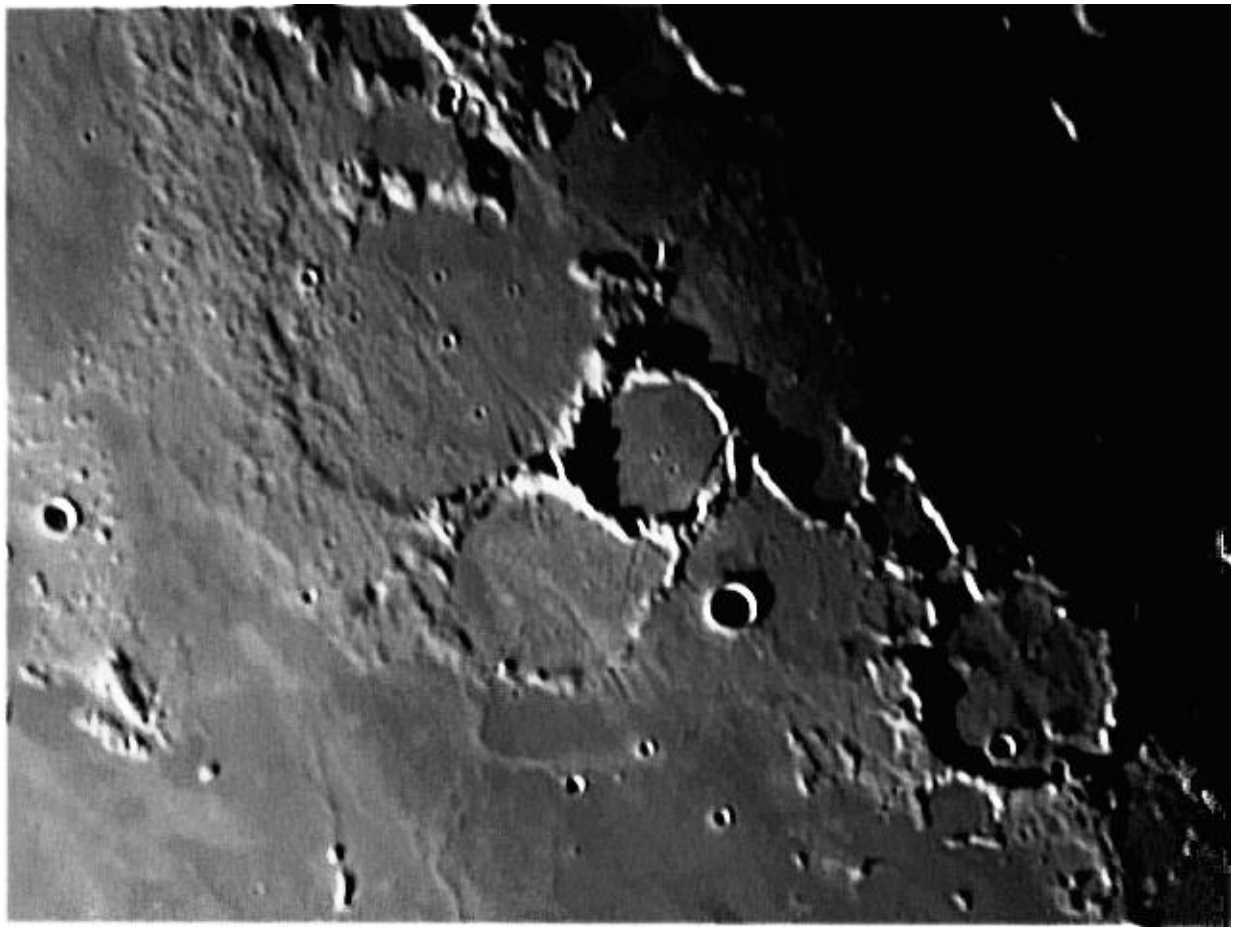


Figure 5. *Fra Mauro at sunset, Alberto Martos, et al., Lunar Group of the Madrid Amateur Astronomy Society, Madrid, Spain. 10 December 2009 0425 UT. Colongitude, 191°, Telescope, 20-cm f/7.3 Newtonian reflector, Philips TouCam Pro. Visibility, 4/5 Transparency, 4/5*

The following notes accompanied Figure 6 (Sketch 2):

> *"The proximity of the terminator suggests expediting (sp.) the work, avoiding too many fine details. The main proposal for this observation was to capture the full Rimae Parry, whose visibility was deficient during last observation (only Rima II was portrayed). Sketch 2 (Figure 6 ed.) shows clearly Rima Parry I and Rima Parry V, running north-south across crater Fra Mauro and converging at the center, just in crater Fra Mauro E. Rima Parry V traverses the rim between Fra Mauro and Bonpland, but the shadow cast by the wall prevents its observation. Under this illumination, the "gully" that seems to separate the scarps Fra Mauro ζ (zeta) and Fra Mauro η (eta), offers an aspect even more dramatic, although the twin Fra Mauro H craters lie under the shadow. The same impressive phenomenon occurs in the landing area."*

I want to thank Alberto Martos, Antonio Noya, Raquel R. Mediavilla, Jaime Izquierdo and Carlos de Luis, and all their colleagues at Madrid Amateur Astronomy Society for their valuable observations, sketches, and images to the ALPO and to this article. It is most appreciated.

Figure 6. *Sketch2 of Craters Fra Mauro, Parry, Bonpland, and Tolansky, Alberto Martos, Jorge Arranz, Carlos de Luis and Fernando Bertran, Madrid, Spain, 13 February 2019 1834-1915 UT, Dobsonian 25 cm f/5, 8mm eyepiece + 2x Barlow (312x), Colongitude 18.2°, Seeing 8/10, Transparency 3/5, north/down, east/left.*

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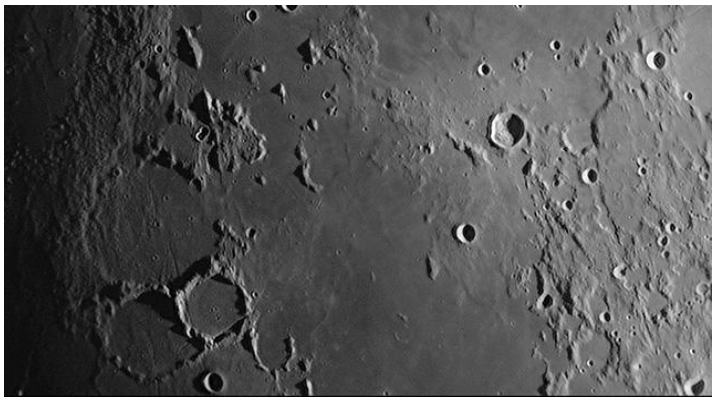
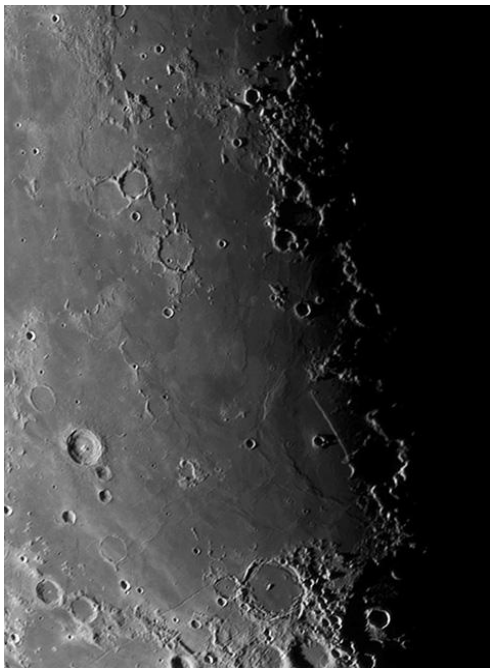
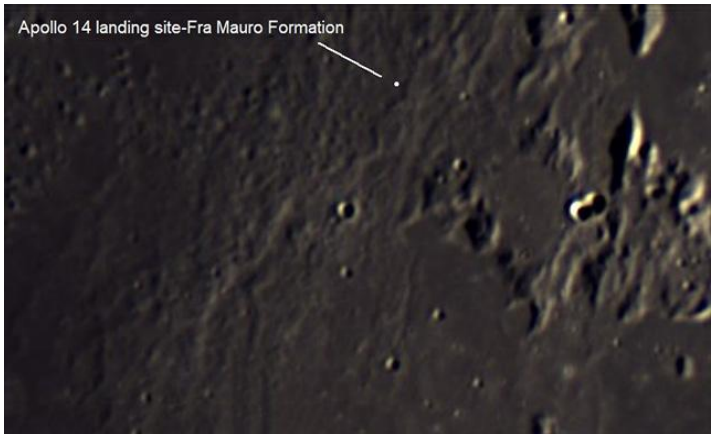
ADDITIONAL FRA MAURO IMAGES



Fra Mauro – *Richard Hill – Tucson, Arizona, USA April 28, 2015 01:20 UT. Seeing 9/10. TEC 8" f/20 Mak-Cass, SKYRIS 445M, 656.3 nm filter.*



Fra Mauro – David Teske, Louisville, Mississippi USA. December 11, 2017 10:41 UT.. Colongitude 183.4°, seeing 4/10, 102mm f/7 APO refractor, ZWO ASI 120mms.



Apollo 14 Landing Site – Myron Wasiuta, Wilderness, Virginia USA. January 15, 2019. 12" LX-200 SCT. QHY5iii290c.

RIGHT SMACK DAB IN THE MIDDLE

Rik Hill

This is a familiar area to the lunar aficionado. The large flat plain in the middle of this image is Sinus Medii with the 27km diameter Triesnecker in the middle of that. To the right is the intricate system of Rimae Triesnecker. Above is another crack in the moon the Hyginus crater cleft as we called it in the old days, now Rima Hyginus with the crater Hyginus (10km) in the center. Below and right are two craters Agrippa (48km) above and Godin (36km) below. At bottom you can see most of the flat floored crater Rhaeticus (51km).

FIGURE 1. SINUS MEDII *– Richard Hill – Tucson, Arizona, USA August 20, 2018 02:30 UT. Colongitude 14.7°. Seeing 7-8/10. TEC 8" f/20 Mak-Cass, SKYRIS 445M, 610 nm filter.*

To the left of Triesnecker Chladni (14km) and beyond it the larger Murchison (60km) and further Pallas (51km). Above these you can see Ukert (24km) with its tiny central peak. In the southern part of Sinus Medii are two similar sized craters, Blagg (5km) to the right and Bruce (7km) on the left. These two lead to several interesting places on the lunar surface. Shown here with the "+" is the point where the latitude and longitude are both zero, **right smack dab in the middle**. This was also the target area for three Surveyor spacecraft. The first, Surveyor 2 had an engine misfire that sent it off towards Copernicus where it crashed on Sept. 23, 1966. The second was Surveyor 4 that arrived in July, 1967 but ceased sending radio signals when it was landing and was not heard from again. The third time is a charm, at least in this case when Surveyor 6 landed just to the east of Surveyor 4 and sent back data successfully in Nov. 1967. The sites of Surveyor 4 and 6 are shown by the appropriate numbers on the image.

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CRATER HOPPING WAY DOWN SOUTH

David Teske

My observational astronomy career began with star hopping from one bright star to another, to some faint fuzzy deep in the sky. Later on, I even "galaxy hopped" through the myriad of galaxies in the area of Virgo. Here I will try to use those skills to find some craters near the lunar South Pole (fig. 1), as seen with good libration (Libration in Latitude -06^{o} 05').

In the image (fig. 2), Tycho is the beautiful fresh crater in the upper left. South of Tycho near the left center of the image is marvelous Clavius. At 245 km in diameter, Clavius is so large that it has been compared to a small mare. With an expanse of 30,000 km^2, which is just slightly smaller than Maryland, is a treasure to view through telescopes large and small. The crater is so large that the curvature of the Moon causes the center of the crater to be higher than its edges. Clavius is one of the largest craters on the Moon that doesn't have a basin's inner ring. Apart from Bailly, Clavius is the largest crater on the near side of the Moon. The thick, rugged, inner terraced

walls rise 3.6 km above the floor of Clavius. Clavius shows its Nectarian age with plenty of degradation caused by large and small secondary impacts and landslips that have occurred at several places along the inner wall which have given Clavius a slightly polygonal shape. For its giant size, Clavius has a small group of central peaks. An astronaut standing on these peaks would be unaware of the huge ramparts that make the walls of Clavius. There is an arc of small craters, artistically and sequentially arranged in order of size, which begins at Rutherfurd, the larger crater just inside the southeast rim, then arcs northward and diminishes towards the west. There are several ridges that extend like fingers northward from Rutherfurd towards Porter on the northern wall. These ridges resemble mare ridges. Both Rutherfurd (48 km) and Porter (51 km) have central mountain massifs. Rutherfurd seems like a relatively fresh crater that shows signs of being an oblique angle impact, such as an offset central peak and an ejecta pattern that suggests a low angle impact from the southeast. A couple of light rays can be traced running southwards from Tycho across the floor of Clavius.

FIGURE 1. ***WANING GIBBOUS MOON*** *– David Teske, Louisville, Mississippi, USA, January 25, 2019 08:43 UT. Colongitude 139.1°, seeing 5/10, 3.5" Maksutov, ZWO ASI 120mms*

Immediately south of Clavius is the 117 km diameter crater Blancanus. This crater has inner walls that are rugged and broken that climb 3.6 km above the floor. The eastern wall is broad and appears quite bright. The floor of the Nectarian period crater Blancanus is fairly smooth except in the south, where there is a cluster of hills and small craters. Just northwest of Blancanus is the similar sized crater Scheiner. Scheiner is a considerably more ancient feature than Blancanus with its floor and wall battered and eroded by numerous impacts. Scheiner has a small crater near its center and another two craters inside its northwest wall. These craters may be secondaries of the Orientale Basin. A ridge of unknown origin extends from Scheiner's south wall across its floor.

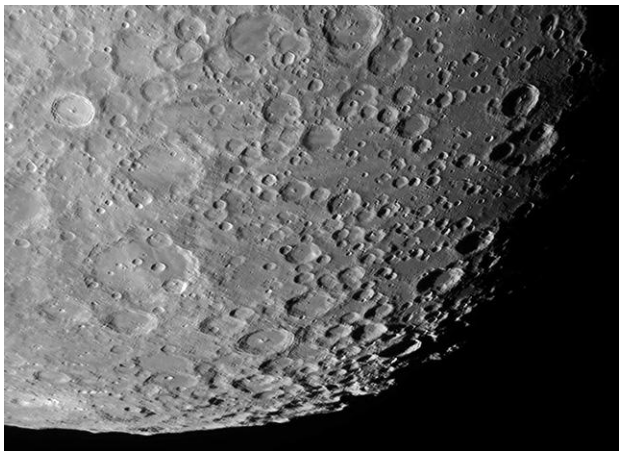

FIGURE 2. ***SOUTH POLAR REGION*** *– David Teske, Louisville, Mississippi, USA, January 25, 2019 09:07 UT.. Colongitude 139.2°, seeing 5/10, 3.5" Maksutov, ZWO ASI 120mms*

Moving straight south of Clavius, about halfway to the southern lunar limb lie a conjoined duo of craters, Klaproth (19 km) and Casatus (111 km). Klaproth is shallower and has a much smoother floor than Casatus. The floor of Klaproth is 0.1 km higher than the floor of Casatus. The wall of Casatus is broader and more sharply defined than that of Klaproth and its floor has a bowl shaped crater, Casatus C (15 km) just north of its center.

Southeast of Clavius, about halfway to the lunar limb is the 110 km diameter fresh young crater Moretus. As one of the most prominent landmarks in the lunar South Polar Region, Moretus

is a fine crater comparable to Theophilus and Copernicus, though it larger than either of these craters. Rather a foreshortened Tycho-class crater, it lacks a dark collar and rays, so is older than Tycho. This crater of the Eratosthenian period has terraced inner crater walls and a large, pyramid-shaped central mountain. This central mountain is the highest of any crater on the Near Side of the Moon with a height around 2.2 km. Moretus has a thick ejecta band around most of its rim, the southern sectors especially. Perhaps this indicates that the crater was the result of an oblique impact.

Just northwest of Moretus lies the 94 km diameter crater Gruemberger. This crater is heavily eroded and older than Moretus. The crater Gruemberger A (20 km) lies on the crater's floor. North of Moretus and encroaching into Gruemberger is the fresh crater Cysatus with a diameter of 49 km. Cysatus has a finely textured interior and a very low central mountain.

Our last crater hop is to the south of Moretus. Just touching the southern glacis of Moretus is the crater Short. Just southwest of Short is Newton. It is a shame that such a pillar of science was put in such a difficult to find location! With a depth of 78 km its depth cannot be precisely measured from Earth because of its extreme location on the limb. The floor of Newton D is 7 km below a mountain on its rim, which is one of the greatest elevation differences on the Moon. It seems Newton is the deepest crater on the Moon, so deep that the rim walls are as high as Mt. Everest. Even further south of Newton a few mountain peaks of the outer rampart of the South Pole Aiken Basin may be observed on the lunar limb.

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LUNAR TOPOGRAPHICAL STUDIES

Coordinator – Wayne Bailey - wayne.bailey@alpo-astronomy.org

Assistant Coordinator – William Dembowski - dembowski@zone-vx.com

Assistant Coordinator – Jerry Hubbell – jerry.hubbell@alpo-astronomy.org

Website: http://moon.scopesandscapes.com/

OBSERVATIONS RECEIVED

SERGIO BAMBINO - MONTEVIDEO, URUGUAY. Digital images of Gassendi & Rimae Sirsalis(2).

JUAN MANUEL BIAGI - ORO VERDE, ARGENTINA. Digital images of lunar eclipse(9).

FRANCISCO CARDINALLI - ORO VERDE, ARGENTINA. Digital images of Aristarchus, Copernicus, la Condamine, Mare serenitatis(2) & Plato(2).

JAIRO CHEVEZ - POPAYÁN,COLUMBIA. Digital images of 3rd Qtr Moon, Aristarchus, Babbage, Billy(2), Copernicus(4), Kepler, Longomontanus, Lunar Eclipse(8), Mare Serenitatis, Philolaus, Plato, Sinus Iridum, Tycho(2)

MAURICE COLLINS - PALMERSTON NORTH, NEW ZEALAND. Digital images of 8, 12, & 24 day Moon & waning crescent earthshine.

WALTER ELIAS - ORO VERDE, ARGENTINA. Digital images of Alphonsus, Chacornac, Plato (3) & Theaetetus.

RICHARD HILL – TUCSON, ARIZONA, USA. Digital image of Sinus Medii.

ALBERTO MARTOS et al - MADRID, SPAIN. Digital images of Fra Mauro(8) & drawings of Fra Mauro(2).

FRANK MELLILO - HOLTSVILLE, NEW YORK, USA. Digital images of Aristarchus, Copernicus, Hesiodus A, Kepler, Marth, Plato & Tycho.

DAVID TESKE - LOUISVILLE, MISSISSIPPI, USA. Digital images of lunar eclipse(5), Fra Mauro, South polar region & waning gibbous Moon.

MYRON WASIUTA - WILDERNESS, VIRGINIA, USA. Digital images of Apollo 14, 15, 16 & 17 sites & Fra Mauro.

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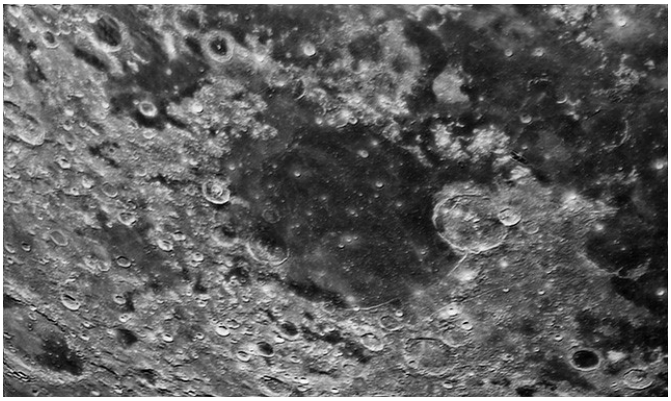
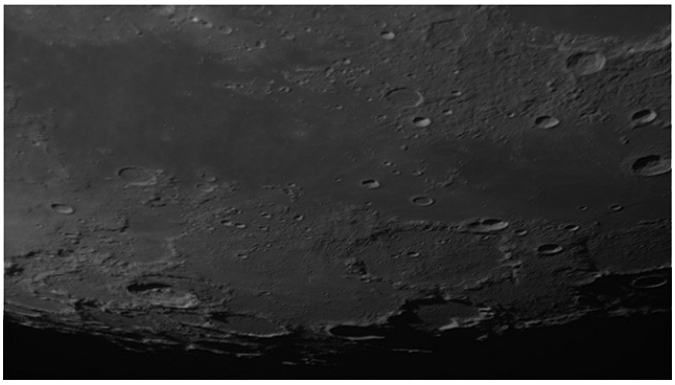


GASSENDI - Sergio Babino,- Montevideo, Uruguay. January 20, 2019 04:17 UT. 8" Astrotech RC. ZWO 174 MM.

RECENT TOPOGRAPHICAL OBSERVATIONS

LUNAR ECLIPSE- Juan Manuel Biagi - Paraná, Argentina. January 21, 2019 04:12 UT. Meade EX-105 Mak-Cass, Canon EOS 400 Rebel



la CONDAMINE - Luis Francisco Alsina Cardinalli, Oro Verde, Argentina, February 17 2019, 03:40 UT, 200mm refractor, QHY5-II, Astronomik ProPlanet 742 IR-pass filter.

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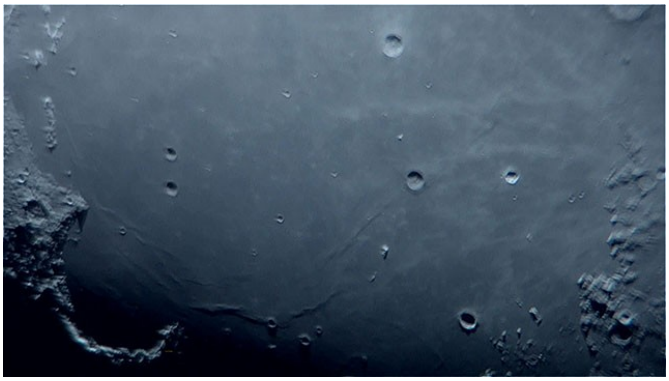

SINUS IRIDUM – Jairo Chavez,- Popayán Columbia. February 15, 2019 02:34 UT. 10" Dobsonian, Sony DSC-WX50.

RECENT TOPOGRAPHICAL OBSERVATIONS

24 day MOON - Maurice Collins,- Palmerston North, New Zealand. January 30, 2019 15:44 UT. ETX-90. Canon 1200D.

THEAETETUS - Walter Elias, Oro Verde, Entre Rios, Argentina. February 12,, 2019 00:15 UT. Celestron CPC-1100, ZWO ASI 120 MM/S

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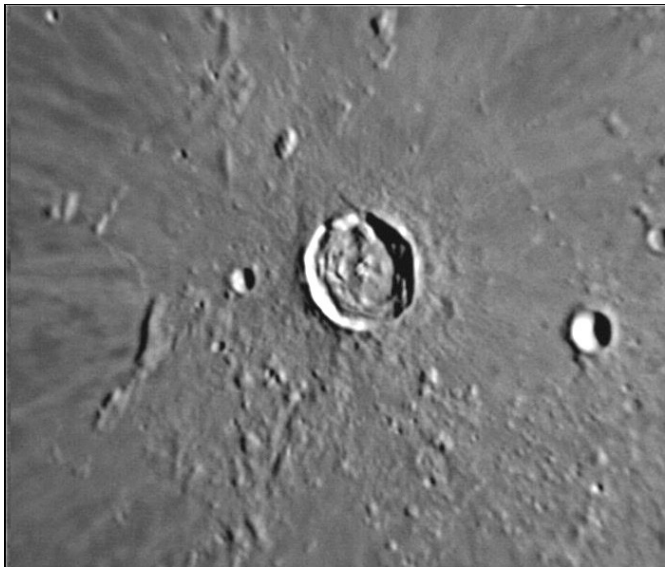
ARISTARCHUS- Frank Melillo, Holtsville, New York, USA. February 17, 2019 01:50 UT. Meade 10" SCT, 2x barlow, 610 nm filter. DMK 21 AU618.AS.

RECENT TOPOGRAPHICAL OBSERVATIONS

HESIODUS A - Frank Melillo, Holtsville, New York, USA. February 17, 2019 02:05 UT. Meade 10" SCT, 2x barlow, 610 nm filter. DMK 21 AU618.AS.



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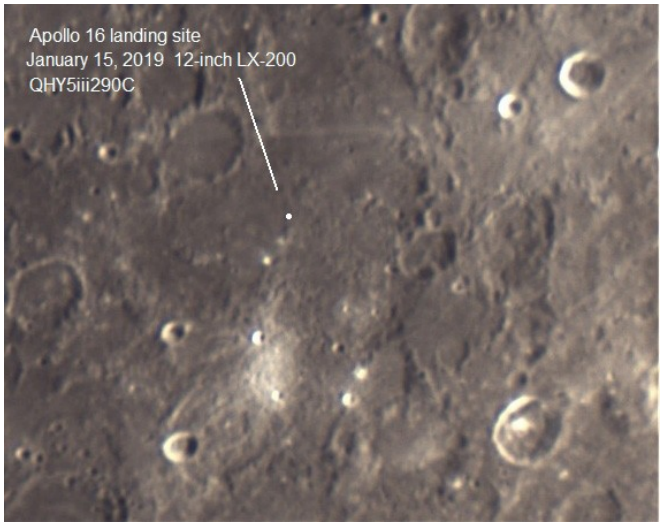
KEPLER - Frank Melillo, Holtsville, New York, USA. February 17, 2019 02:11 UT. Meade 10" SCT, 2x barlow, 610 nm filter. DMK 21 AU618.AS.



Apollo 16 Landing Site – Myron Wasiuta, Wilderness, Virginia USA. January 15, 2019. 12" LX-200 SCT. QHY5iii290c.

LUNAR GEOLOGICAL CHANGE DETECTION PROGRAM

Coordinator – Dr. Anthony Cook – atc@aber.ac.uk

Assistant Coordinator – David O. Darling - DOD121252@aol.com

.Reports have been received from the following observers for January: Jay Albert (Lake Worth, FL, USA - ALPO) observed: Alphonsus, Aristarchus, Arzachel, Atlas, Eimmart, Gassendi, Herodotus, the lunar eclipse, Manillius, Picard and Tycho. Alberto Anunziato (Argentina – SLA/LIADA) observed Aristarchus, Atlas, Byrgius, Grimaldi, Kepler, and Tycho during the lunar eclipse. Simon Bell (Mid Wales, UK - NAS/Slooh) imaged several features. Juan Manuel Biagi (Argentina – SLA/LIADA) imaged the lunar eclipse. Jairo Andres Chavez (Columbia – LIADA) imaged: Aristarchus, Babbage, Billy, Copernicus, Longomontanus, the lunar eclipse, Philolaus, Plato and Several Features. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged earthshine md several features). Anthony Cook (Newtown, UK – ALPO/BAA) imaged several features and videoed the lunar eclipse. Marie Cook (Mundesley, UK – BAA) observed Alphonsus, Aristarchus, Censorinus, Grimaldi and Plato). Valerio Fontani (Italy – UAI) imaged Maurolycus. Les Fry (UK - NAS) imaged earthshine and the lunar eclipse. Brandon Lane (Welshpool, UK – NAS) imaged the lunar eclipse and watched it visually. Dr Heather McCreadie (Aberystwyth University) watched the lunar eclipse visually with and without binoculars. Paolo Moramarco (Italy – UAI) imaged the Full Moon just prior to the lunar eclipse. Franco Taccogna (Italy – UAI) imaged the lunar eclipse, the lunar north pole, Mare Humorum, and Torricelli B, Aldo Tonon (Italy-UAI) imaged the lunar eclipse. Gary Varney (Pembroke Pines, FL, USA – ALPO) imaged: Alphonsus, Lamont, the lunar eclipse and several features. Luigi Zanatta (Italy – UAI) imaged the lunar eclipse.

LTP reports: No LTP were observed in January - other than the 21/1/2019 impact flash during the lunar eclipse.

Routine Reports: Below are a selection of reports received for January that can help us to re-assess unusual past lunar observations – if not eliminate some, then at least establish the normal appearance of the surface features in question. Due to pressure of work I did not have time to analyze most of these – but will go through them next month in summary form.

Earthshine: On 2019 Jan 09 UT 18:19 Les Fry (NAS) imaged earthshine, and although not during a repeat illumination, or lunar schedule prediction, it does exhibit a nice sunlit peak offset from the southern crescent in Fig 1. This effect has tricked some observes in the past into thinking they had seen a LTP here, but it is normal!

Maurolycus: On 2019 Jan 12 UT 19:39-19:51 Valerio Fontani (UAI) and UT 19:41-22:02 Leonardo Mazzei (Gruppo Astrofili Montagno Pistoiese – UAI) imaged this crater (See Fig 2) for a request by the Lunar Schedule web site:

> *ALPO Request: On 2012 Feb 28 Raffaello Braga noted that only the tip of the central peak was visible. Most of the crater was in darkness - this was normal at this stage in illumination. When viewed through a red filter, the central peak was visible, however when viewed through a blue filter it was invisible. Please try to observe this crater visually with red and blue filters, to see if you can replicate this effect? If so, then check for similar effects on other*

craters on the terminator. Otherwise try to obtain some high-resolution color images. This work is suitable for telescopes of 4" aperture or larger - if you have a choice of a refractor or a reflector, please try the refractor. Please send any observations you make to: a t c @ a b e r . a c . u k

Figure 1. *The crescent Moon with earthshine taken by Les Fray (NAS) on 2019 Jan 09 UT 18:19 and orientated with north towards the top.*

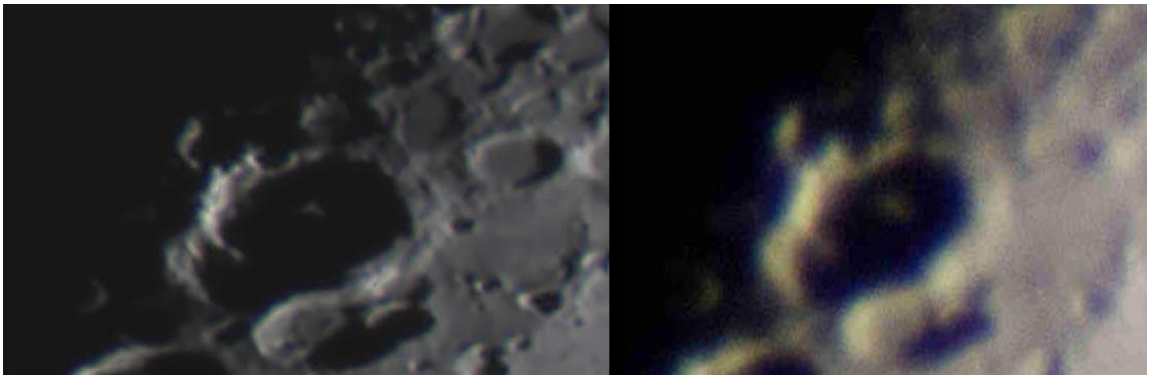


Figure 2. *Maurolycus orientated with north towards the top.* ***(Left)*** *An image by Valerio Fontani (UAI) taken at 19:47 UT, through a reflector.* ***(Right)*** *An image by Leonardo Mazzei (Gruppo Astrofili Montagno Pistoiese – UAI) taken with a refractor at 19:52UT.*

Plato: On 2019 Jan 15 UT 23:55 Jairo Andres Chavez (LIADA) imaged (Fig 3) the crater under similar illumination (to within ±0.5°) to the following report:

Plato 1937 Dec 12 UT 16:45-21:00 Observed by Barker (Chestnut, England, 12.5" reflector x420) and Fox (Newark, England, 6.5" reflector, 24?x) "Strong streak of orange-brown on E. wall. Floor nearly clear of shad. composed of many veins & thin streaks interwoven. At 21h irreg. extension seen spreading eastward down wall. Confirmed by Barker's younger son. NASA catalog weight=5. ALPO/BAA weight=4. NASA catalog ID #428.

Torricelli B: On 2019 Jan 17 Franco Taccogna (UAI) imaged this area (See Fig 4) under similar illumination & topocentric libration (to within ±1°) to the following report:

Torricelli B 1995 Apr 11 UT 20:15 Observed by North (UK). "Color moonblink reaction, and crater dull". BAA Lunar Section report. ALP\BAA weight=3.

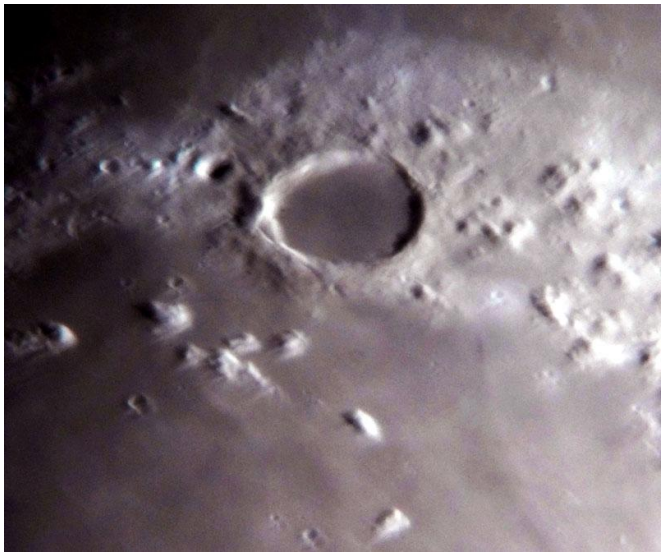


Figure 3. *Plato as imaged by Jairo Andres Chavez (LIADA) on 2019 Jan 15 UT 23:55 and orientated with north towards the top.*

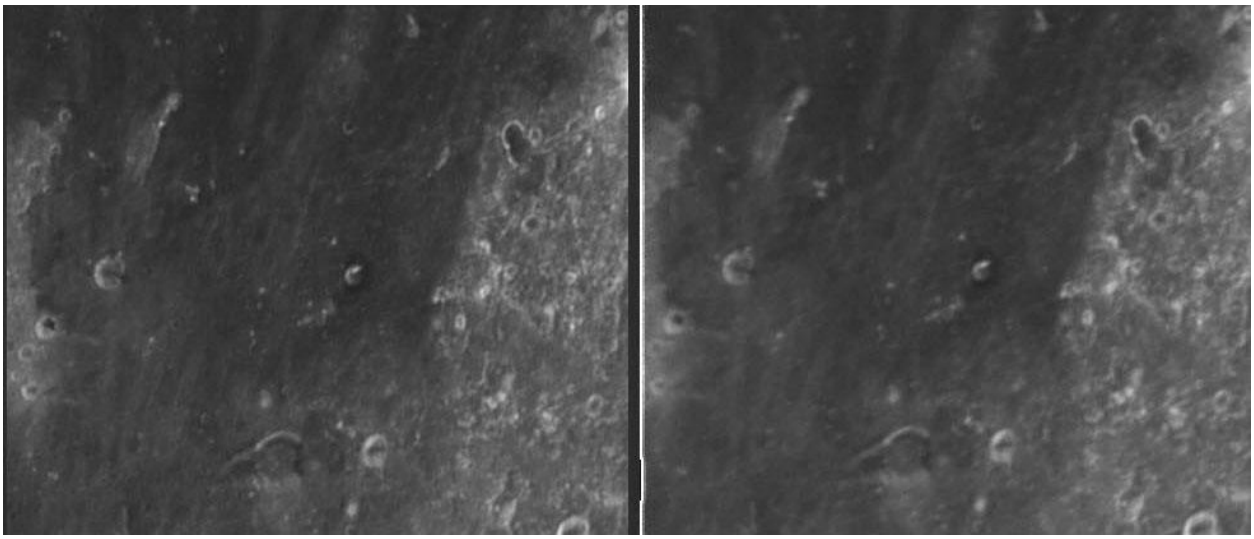


Figure 4*. Torricelli B - the small crater close the image center, as captured by Franco Taccogna (UAI) on 2019 Jan 19 UT17:49, with north towards the top.* ***(Left)*** *A red image.* ***(Right)*** *A blue image.*

I contacted Gerald over this observation and he provided me with a little more detail over what he saw – though he did not regard it as a LTP at the time due to the seeing conditions:

- *19h 16m - 19h 23m UT, X104: "Torricelli B strikes me as unusually prominent, though I am unfamiliar with the view at this power (first night of trying a 25 mm Kellner eyepiece)."*
- *19h 23m - 19h 28m: UT "Examine Torricelli B at X144 and X207. Decide that it looks fairly normal, after all. However, the boiling and blurry image makes a proper assessment difficult. The image is generally very fuzzy at X207".*
- *A couple of raster-scans then made, first in integrated light, then in green light - both normal for the entirety of the sunlit Moon.*
- *20h 00m - 20h 10m UT. Raster-scan, X144. Deep red filter.: "All seems normal, - except perhaps Torricelli B which is practically invisible in the red filter!".*

- *Further raster scans in integrated light. All seems normal, as far as could be ascertained in the very poor seeing.*

I believe that I was probably videoing the Moon at the time in 1995 - so between now and next month will look this up, feed it through Registax and see what I can come up with in comparison to Franco's image.

Herodotus: On 2019 Jan 18 UT 02:30-03:15 Jay Albert (ALPO) observed and imaged (See Fig 5) this crater under similar illumination (to within ±0.5°) to the following 2 reports:

On 2003 May 13 at UT06:40-07:26 W. Haas (Las Cruces, NM, USA, 12.5" reflector, x321 and x202, S=2, T=3.5) suspected (06:40-06:55UT) that he saw an oval bright feature (intensity 5.5) near the center of the floor of Herodotus crater indenting into the shadow - however the seeing was none too good, so it is more of a suspicion than a definite sighting. At 07:14-07:26UT he re-examined the region (x202 and x321, S=1-2 and T=3.5) and had better glimpses that conformed his initial suspicions of there being an oval indentation bright spot (now intensity 6) into the shadow in the center of the floor. Of course, Herodotus does not have a central peak! There was also a very bright spot on the NW> sunlit rim of Herodotus crater. The ALPO/BAA weight=2.

On 2017 Sep 02/03 UT 23:55-00:30 A. Anunziato (Parana, Argentina, 105 mm Maksutov-Cassegrain, x154, seeing 6/10, some interruption from clouds) observed a light spot SE of the center of the floor of the crater, which came and went in visibility. There is a light spot here, but what was unusual was that the visibility decreased over time. ALPO/BAA weight=1.

Figure 5. *Aristarchus and Herodotus, taken by Jay Albert (ALPO) on 2019 Jan 18 UT 03:01 and orientated with north towards the top.*

Jay commented that: *"More than half the crater floor was in shadow with one prominent dome-shaped shadow just S of center stretched all the way to the base of the interior W wall, which was well lit. I saw no bright oval protruding into the shadow on the central part of the floor. I did, however, easily see the bright spot on the NW crater wall as per the LTP description. This spot was clearly seen to be a craterlet on the NW rim and is labeled "N" on Rukl chart 18. I observed visually from 02:30 to 02:50 at 290x. I then noticed that my optical tube was dewing up (fortunately, not my corrector plate) and more thin clouds were approaching, so I quickly attempted a few quick cellphone photos before shutting down"*

Archimedes: On 2019 Jan 19 UT 00:11 Gary Varney (ALPO) imaged (Fig 6) the whole Moon, but this covered the following region to within ±0.5°:

Figure 6*. Archimedes from a larger image taken by Gary Varney (ALPO) on 2019 Jan 19 UT 00:11 and orientated with north towards the top.*

On 1988 Sep 23 at 19:40-19:55 & 20:36-20:41 G. North (760mm Coude Refractor, x250, Royal Greenwich Observatory, Herstmonceux, UK, seeing V, Transparency: Fair). 19:40-19:55 image very unsteady. All seems normal in other craters with the exception of Archimedes. Much of the rim seems indistinct apart from a 1/4 length of the west rim. Strongly suspected that this was due to a combination of seeing and illumination. UT 20:02-20:06 - checked the area with a lower magnification 10" Astrographic Refractor - the crater seems more normal, so suggesting that the theory was correct. 20:36-20:41 returned to the 30" reflector, and the crater appeared similar to the start of the session. This is almost certainly not a LTP, but it would be helpful to have some images or sketches to check this theory out. Weight=1.

Unknown: On 2019 Jan 19 UT 05:49 Simon Bell (Mid Wales, UK – NAS/Slooh) imaged (See Fig 7) a large area of the Moon remotely using the Slooh Chile 1 robotic scope to within ±0.5°in terms of illumination to the following report:

On 1960 Sep 04 at UT00:00? Miranova (Russia or Israel) observed a LTP at an unnamed lunar feature: "Spectral photom. of some lunar obj. in 4250, > 5000A bands. Spectral plates". Cameron suspects luminescence? The Cameron 1978 catalog ID=730 and weight=5. The ALPO/BAA weight=1.

Censorinus: On 2019 Jan 20 UT 20:10-20:15 Marie Cook (BAA) observed this crater under similar illumination (to within ±0.5°) of the following report:

On 1982 Jan 09 at UT 18:46-21:42 P. Moore (Selsey, UK) and other observers noted Censorinus was exceptionally bright. Cameron 2006 catalog ID=162 and weight=5. ALPO/BAA weight=2.

Marie, working under Antoniadi III seeing conditions, found the crater to be what she regarded as normal in brightness.

Grimaldi: On 2019 Jan 20 UT 22:54 Paolo Moramarco (UAI) imaged (See Fig 8) the whole Moon that matched to within ±0.5° to this binocular report from prior to a penumbral eclipse from 1976:

On 1976 Nov 06 at UT 18:26 M. Herbert (10x50 binoculars, Western Supermare, UK) noticed a thin line that appeared to be dark red (almost black) around the Gassendi area. This is BAA Lunar Section report. The ALPO/BAA weight=1.

Figure 7 *Image of the Moon captured by Simon Bell (NAS) via the Slooh Chile 1 scope, taken on 2019 Jan 19 UT 05:49 and orientated with north towards the top.*

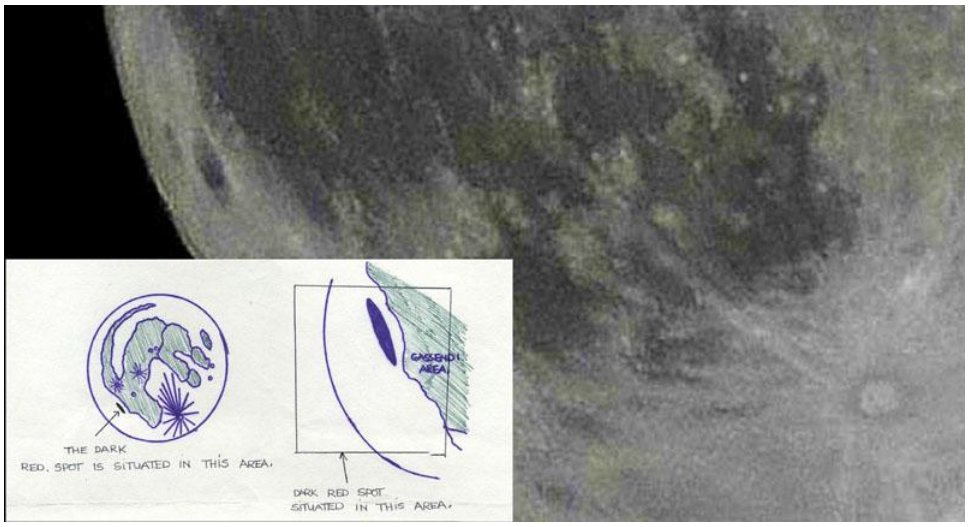


Figure 8 *Image by Paolo Moramarco (UAI) on 2019 Jan 20 UT 20:54 with color saturation increased to 50% and orientated with north towards the top. Inset are the sketches made by Mark Herbert, in a letter sent to Patrick Moore concerning an observation on 1976 Nov 06.*

It is very obvious from Fig 8 (Inset) that the thin almost black line is simply Grimaldi. Not sure why it would have appeared red – perhaps chromatic aberration in the binoculars or atmospheric spectral dispersion as the Moon was at a low altitude of 16°. There was a penumbral eclipse on that date but it did not start until 20:48UT, so this could not have contributed any color. There is no natural color here as seen in Fig 8. Because the instrument had a small aperture and small magnification, I have decided to take this off the LTP database, as the observer did not

even know the name of the crater in their report was Grimaldi. I shall assign a weight of 0.

Tycho: On 2019 Jan 21 Alberto Anunziato (SLA/LIADA) observed the lunar eclipse to within ±0.5° of illumination of the following Tycho reports:

Tycho 1956 Nov 17/18 UTC 23:30-00:30 Observed by Argentiere et al. (France?) "Crater was extra-ordinarily bright". NASA catalog weight=3. NASA catalog ID #658.

On 1919 Nov 27 at UT 23:00-01:00 Fock (Germany) observed in the vicinity of Tycho, during an eclipse (mid eclipse at 23:56UT) a long ray in the direction of Longomontanus that remained visible. It was glowing in weak gray-green color for the whole of the eclipse. The Cameron 1978 catalog ID=373 and weight=2. The ALPO/BAA weight=1.

At 04:06-04:12 UT Alberto commented that: *"Tycho was in the umbra but you could clearly discern 5 rays. One of them was brighter than the others, the one heading to Longomontanus (marked with an arrow in the sketch in Fig 9)"*

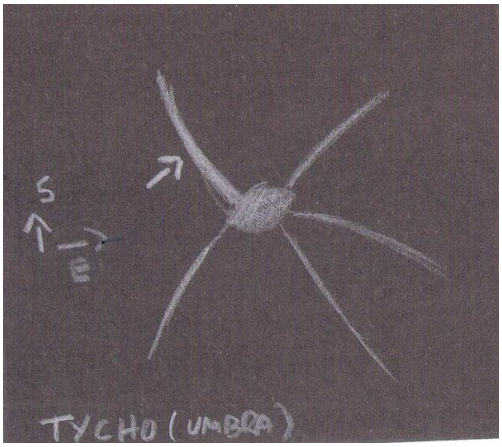


Figure 9 A sketch of Tycho by Alberto Anuziato (SLA/LIADA) made on 2019 Jan 19 UT 04:06-04:12. This is in mirror image projection and orientated with north towards the bottom.

Lunar Eclipse: On 2019 Jan 30 at approximately 04:30 UT Brandon Lane (NAS) observed a shooting star near to the Moon (See Fig 10).

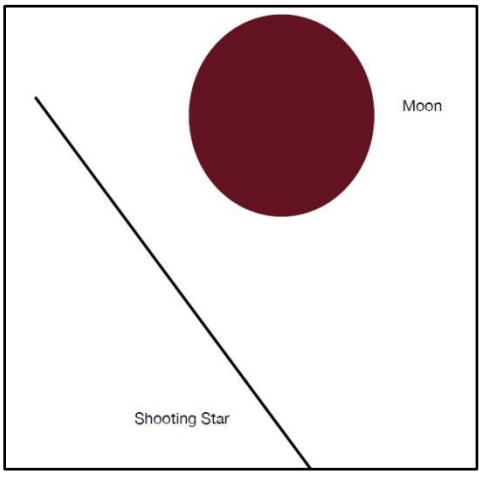


Figure 10. A naked eye sketch by Brandon Lane (NAS) made from Welshpool, UK on 2019 Jan 30 UT ~04:30.

Shooting stars in our atmosphere do occasionally appear close to the line of sight with the Moon – just by chance, though this was not the same one which caused an impact flash as mentioned in the last newsletter as that was on the Moon whereas shooting stars are in our atmosphere. But what Brendan saw may have been similar to the reported streak effect seen by Dr Heather McCredie from Aberystwyth, also mentioned last month – though the 68 km (42 miles) separation between the observers and parallax calculations for meteors in our atmosphere suggests otherwise, and they may have been separate sightings of different shooting stars at different times? Interestingly there were no predicted showers that night so whatever was seen must have been sporadic.

We have received lots of other lunar eclipse images (not of the meteor or the impact flash) and these will be discussed in next month's newsletter – due to time and page constraints this month.

Earthshine: On 2019 Jan 30 UT 15:38 Maurice Collins (ALPO/BAA/RASNZ) imaged (See Fig 11) the Moon in earthshine during a requested observing time on the Lunar Schedule web site for impact flash studies:

Although Maurice's image (Fig 11) shows no impact flashes, it serves a reminder that like the evening, the early morning is a good time to look for impacts, i.e. before local sunrise, though low light video is the best method of detecting these.

Figure 11 *Image of earthshine as captured by Maurice Collins on 2019 Jan 30 UT 15:38 and orientated with north towards the top.*

:**General Information:** For repeat illumination (and a few repeat libration) observations for the coming month - these can be found on the following web site: http://users.aber.ac.uk/atc/lunar_schedule.htm . By re-observing and submitting your observations, only this way can we fully resolve past observational puzzles. To keep yourself busy on cloudy nights, why not try "Spot the Difference" between spacecraft imagery taken on different dates? This can be found on: http://users.aber.ac.uk/atc/tlp/spot_the_difference.htm . If in the unlikely event you do ever see a LTP, firstly read the LTP checklist on http://users.aber.ac.uk/atc/alpo/ltp.htm , and if this does not explain what you are seeing, please give me a call on my cell phone: +44 (0)798 505 5681 and I will alert other observers. Note when telephoning from outside the UK you must not use the (0). When phoning from within the UK please do not use the +44! Twitter LTP alerts can be accessed on https://twitter.com/lunarnaut .

Dr Anthony Cook, Department of Physics, Aberystwyth University, Penglais, Aberystwyth, Ceredigion, SY23 3BZ, WALES, UNITED KINGDOM. Email: atc @ aber.ac.uk. .

KEY TO IMAGES IN THIS ISSUE

1. **Archimedes**
2. **Aristarchus**
3. **Euctemon**
4. **Gassendi**
5. **Hesiodus**
6. **Kepler**
7. **la Condamine**
8. **Maurolycus**
9. **Plato**
10. **Sinus Iridum**
11. **Sinus Medii**
12. **Theaetetus**
13. **Torricelli**
14. **Tycho**

FOCUS ON targets

X = Apollo 14 Fra Mauro
Y = Apollo 12 Ocean of Storms
Z = Apollo 11 Sea of Tranquility